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Milne et al.

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(54) **METHOD AND APPARATUS FOR MAKING A WATER DRAINAGE-PROMOTING WRAP**

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(73) Assignee: **Owens Corning Intellectual Capital, LLC**, Toledo, OH (US)

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This patent is subject to a terminal disclaimer.

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E04B 1/62 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***E04B 1/625*** (2013.01); ***E04B 1/665*** (2013.01); ***E04D 12/002*** (2013.01); *Y10T 428/24802* (2015.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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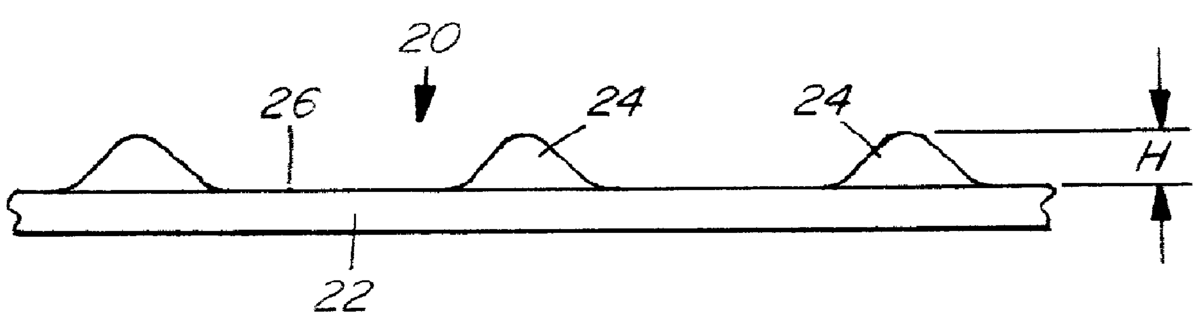
(57) **ABSTRACT**

A method and apparatus for making a water drainage-promoting wrap for applications such as housewrap and roofing underlayment. A substrate, which may be breathable or non-breathable, is conveyed through a nip between a rotating sleeve and a roll, the sleeve having a plurality of apertures therein. A fluid resin composition is fed into the sleeve and is fed out through the apertures in the sleeve as it rotates and as the substrate moves through the nip, forming spaced-apart spacer elements on a face of the substrate. The spacer elements are then dried or cured.

8 Claims, 4 Drawing Sheets



Related U.S. Application Data

(60) Provisional application No. 61/482,426, filed on May 4, 2011.

(51) **Int. Cl.**
E04B 1/66 (2006.01)
E04D 12/00 (2006.01)

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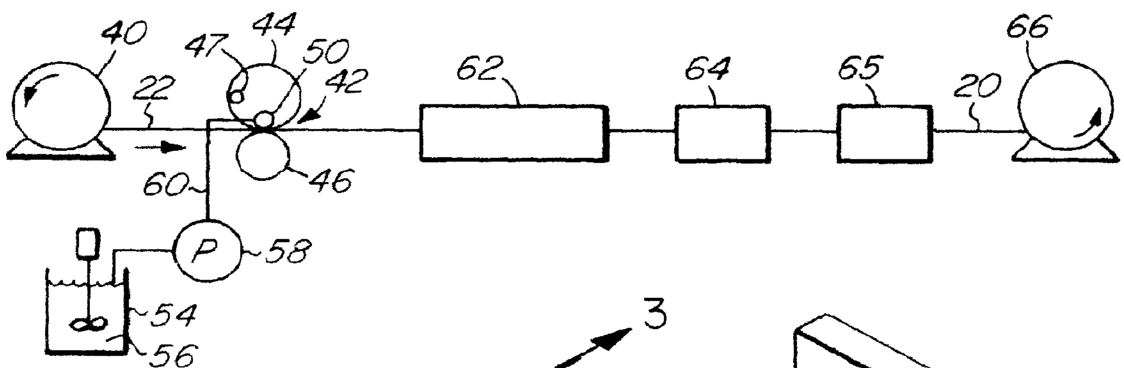
FIG. 1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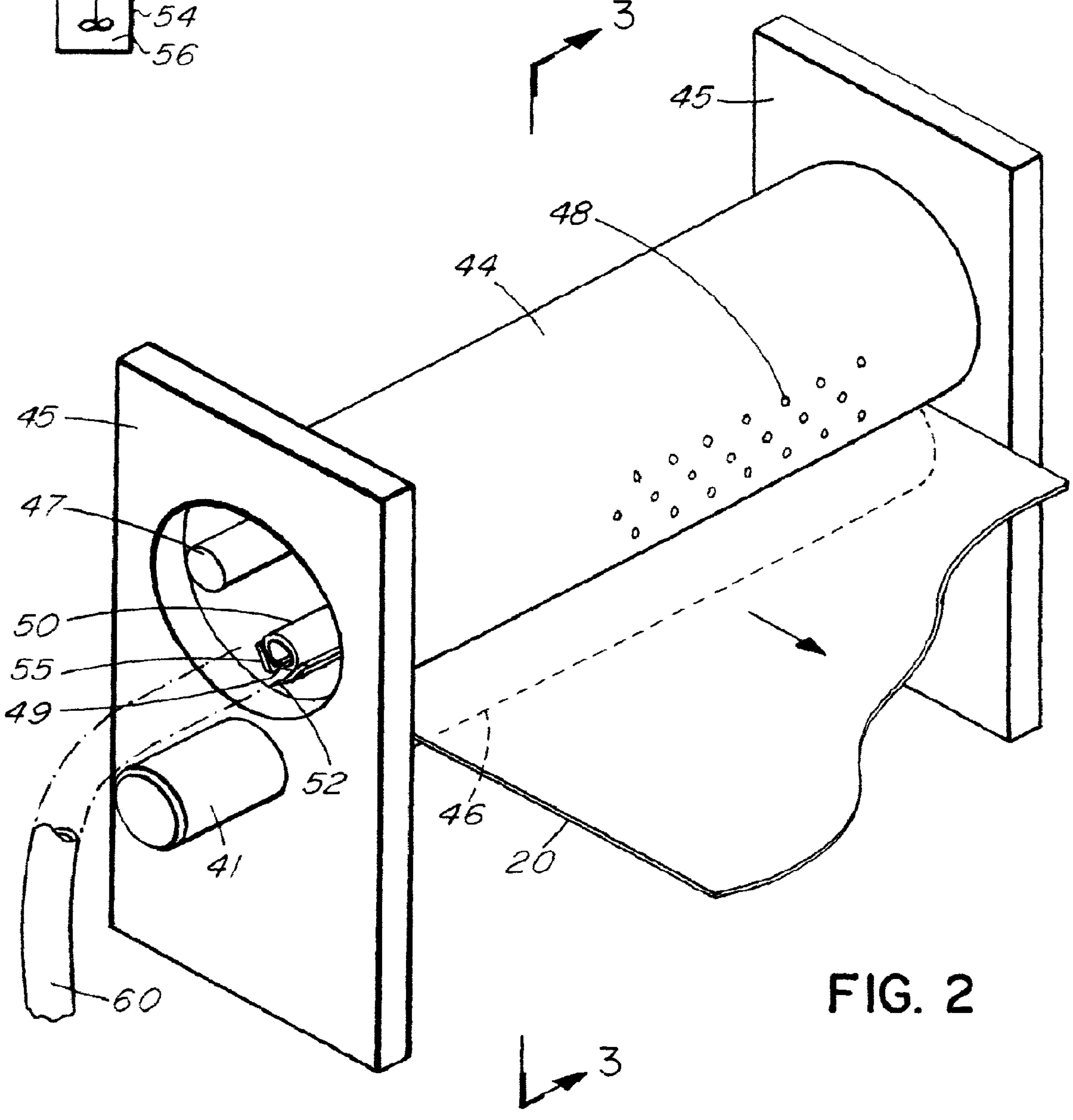
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FIG. 2

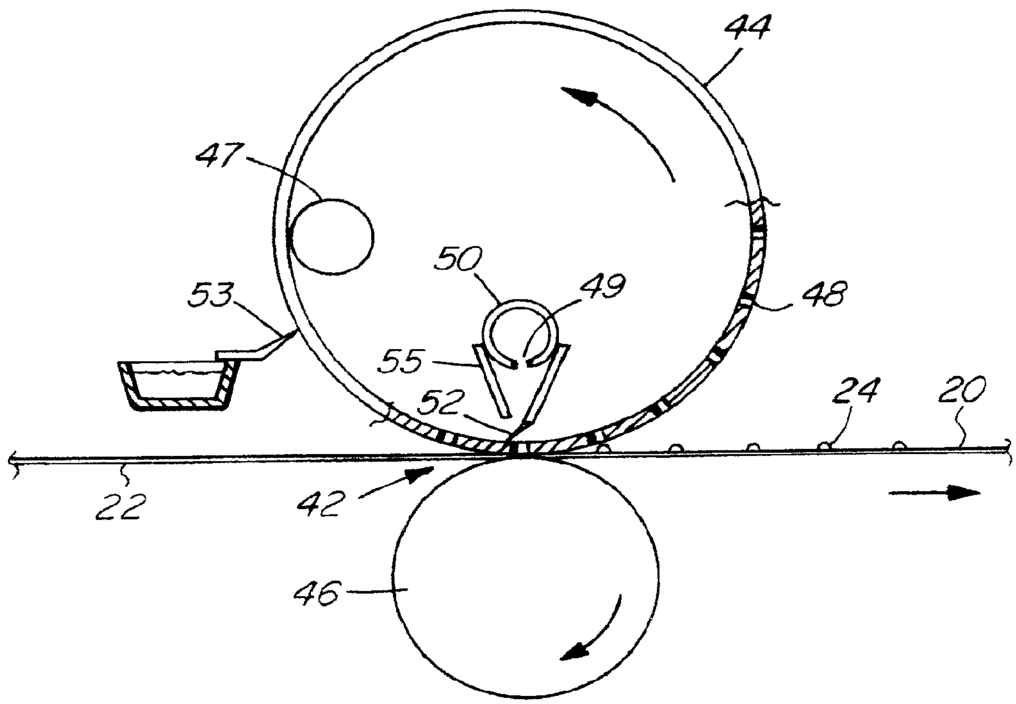


FIG. 3

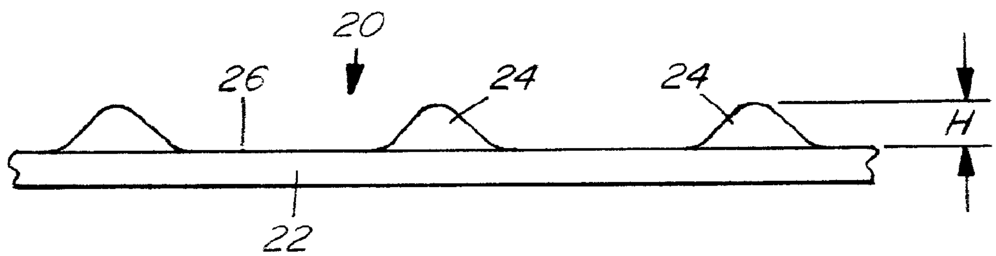


FIG. 4

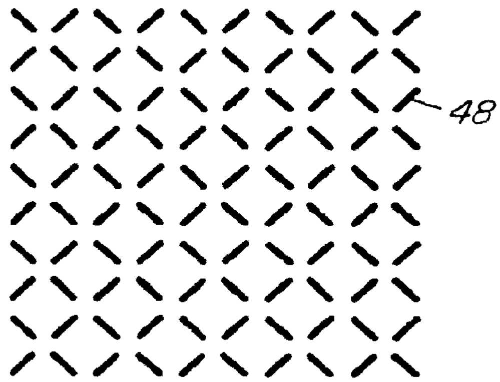


FIG. 5A

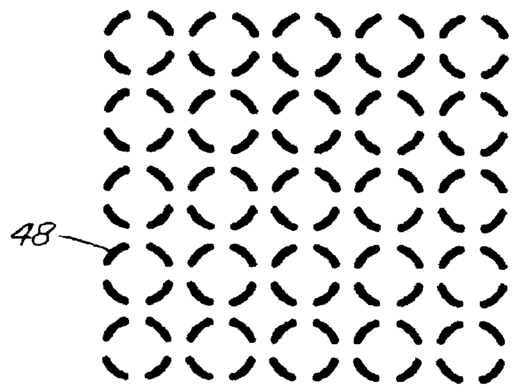


FIG. 5B

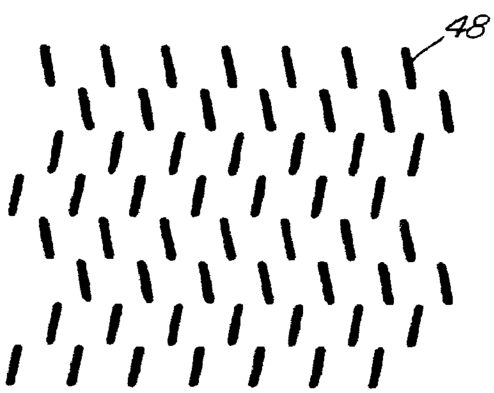
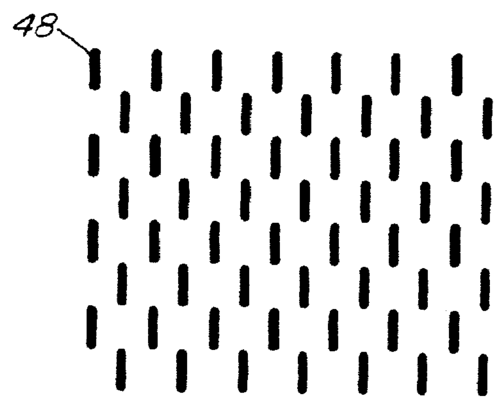


FIG. 5C



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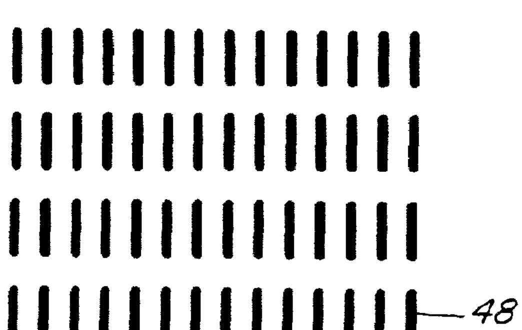

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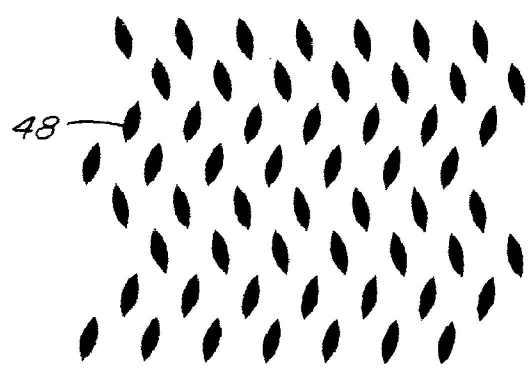

FIG. 5F

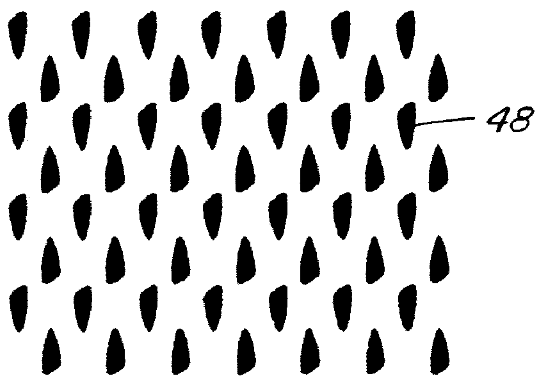

FIG. 5G

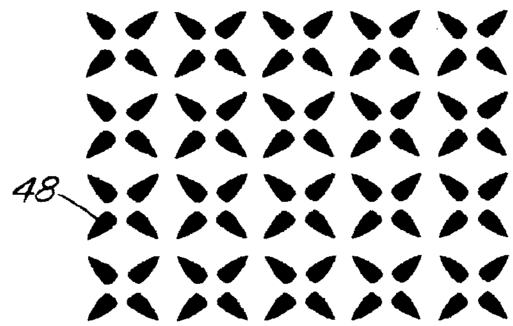

FIG. 5H

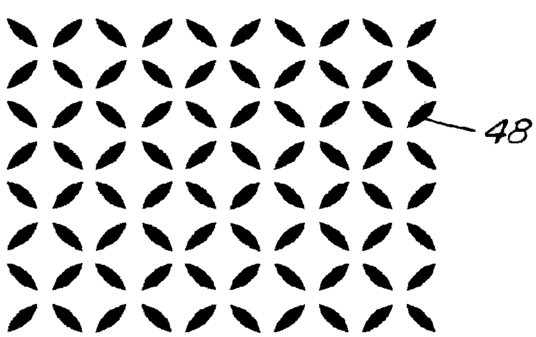

FIG. 5I

METHOD AND APPARATUS FOR MAKING A WATER DRAINAGE-PROMOTING WRAP

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. application Ser. No. 14/115,311, filed on Jan. 27, 2014, which is a National Stage Entry of PCT/CA2012/000411, filed on May 1, 2012, which claims priority to U.S. Provisional Application No. 61/482,426, filed on May 4, 2011, the disclosures of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

The invention pertains to wraps suitable for use as housewrap or roofing underlayment, in which the wrap facilitates water drainage within the wall or roof, and to methods and apparatus for making the wraps.

BACKGROUND OF THE INVENTION

It is common practice in the construction industry to apply a wrap that is resistant to penetration by liquid water and air in the construction of the exterior walls and roofs of building structures. Such wraps are commonly referred to as housewraps or roofing underlayments. Typically, housewraps and roofing underlayments are also breathable, i.e. permeable to water vapor, to help prevent the buildup of moisture within the walls and roof of a building, which can cause mold and rot and be highly damaging to the structure, though some roofing underlayments are non-breathable.

It is known to apply drainage-promoting means to such construction wraps. For example, Ehrman et al., U.S. Pat. No. 7,607,270, discloses a wrap comprising a weather-resistant membrane and a series of spaced-apart, elongate filament spacers bonded to the membrane and having depressions providing drainage paths.

The present invention is direct to improvements in drainage-promoting wraps and to methods and apparatus making them.

SUMMARY OF THE INVENTION

The invention provides a method of making a water drainage-promoting wrap for applications such as housewrap and roofing underlayment. A substrate, which may be breathable or non-breathable, is conveyed through a nip between a rotating sleeve and a roll, the sleeve having a plurality of apertures therein. A fluid resin composition is fed into the sleeve and is fed out through the apertures in the sleeve as the sleeve rotates and the substrate moves through the nip, forming a plurality of spaced-apart spacer elements on a face of the substrate. The spacer elements are then dried or cured. The invention also provides a wrap made according to the foregoing method.

The process permits the formation of intricate designs and patterns of spacer elements that can promote water drainage regardless of the orientation in which the wrap is installed. The process also permits the use of specialized resin formulations, for example formulations having very low surface energy to aid in water flow.

In the prior art, filament extrusion to form spacer elements is limited to the use of substrates with which the filament material is compatible in order for it to adhere. In the present invention, the flexibility in resin compositions and the manner of applying it to the substrate allows for a broader variety of substrates. Further, the invention permits the profile of rolls of the wrap to be managed by means of an appropriate spacer pattern selection in order to reduce buildup in the roll, permitting longer roll lengths with smaller diameters.

According to another embodiment, the invention provides an apparatus for making a water drainage-promoting wrap, comprising a rotatable, cylindrical sleeve having a plurality of apertures therein, the apertures being arranged for the flow of a fluid resin composition from the inside of the sleeve onto a substrate, which may be breathable or non-breathable, to form discrete, spaced-apart spacer elements on the face of the substrate; a rotatable roll, the sleeve and roll being arranged to form a nip for the passage of the substrate; means for feeding the substrate through the nip; a tray inside the sleeve for receiving the fluid resin composition, the tray being spaced from an inner surface of the sleeve and having an opening for release of the fluid resin composition; means for feeding the fluid resin composition to the tray; a doctor blade inside the sleeve in contact with the inner surface of the sleeve; and means for drying or curing the spacer elements on the substrate.

Further aspects of the invention and features of specific embodiments of the invention are described below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic drawing of an embodiment of the process for making the wrap.

FIG. **2** is a perspective view of an embodiment of the apparatus for applying spacer elements.

FIG. **3** is a cross-sectional view on the line **3-3** of FIG. **2**.

FIG. **4** is a cross-sectional view of the wrap.

FIGS. **5**A to **5**I are plan views of representative drainage pattern designs on the sleeve.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. **1**, in general terms the process for making the wrap **20** involves processing a substrate **22** by bonding spacer elements **24** to one face **26** of the substrate and drying or curing the spacer elements.

The substrate **22** is a membrane selected to be substantially impermeable to liquid water and air. It may be permeable or impermeable to water vapor. It may be monolithic, non-woven or woven, a single layer or a composite. It may comprise a polymeric resin, including thermoplastic elastomer and polyolefins such as polyethylene and polypropylene. It may be microperforated. The substrate would typically have a thickness in the range of about 3 to 22 mil, depending on the structure of the fabric. One example of a suitable substrate is a coated woven fabric comprising a woven scrim coated on one or both sides with a breathable coating, or alternatively coated on one or both sides with a non-breathable coating and then perforated to make it breathable. This structure would typically be either polyethylene or polypropylene and have a thickness in the range of about 3 to 12 mil. Another example of a substrate is a coated non-woven fabric coated on one or both sides with a breathable coating. This structure would typically be either polypropylene or polyethylene, alternatively polyester, and have a thickness in the range of about 6 to 18 mil. Another example of a substrate is a coated non-woven fabric composite containing two or more non-woven base fabrics that are coated or laminated together with a breathable coating.

It can optionally include an open scrim or reinforcement laminated inside the composite. This structure would typically be either polypropylene or polyethylene, alternative polyester, and have a thickness in the range of about 10 to 22 mil. Examples of commercially-available substrates that can be used are Titanium (trademark) roofing underlayment supplied by InterWrap Inc. and Tyvek (trademark) housewrap supplied by DuPont.

The substrate **22** is fed from an unwinding roll **40** into a nip **42** between an upper rotatable resin-transfer sleeve **44** and a lower rotatable roll **46** supported by a frame **45**. The roll **46** is a driving roller powered by a motor **41** and it rotates the sleeve. The sleeve **44** is a substantially hollow cylinder having a plurality of spaced-apart apertures **48** across its surface. The apertures **48** can be in various patterns, examples of which are shown in FIG. **5**.

As best seen in FIGS. **2** and **3**, a tray **50** extends through the length of the sleeve, elevated above the bottom of the sleeve. The tray **50** is a cylindrical container, open along a slot or opening **49** extending along its lower side for the resin composition to flow out of the tray and into a V-shaped channel **55**, attached to the tray and open at its lower edge, and then into contact with the sleeve. A doctor blade **52** extends along the length of the sleeve from one side of the channel **55** to the inner surface of the sleeve to confine the resin composition within the sleeve and to clean the inner surface of the sleeve and help push the resin through the apertures **48**. A second doctor blade **53** contacts the outside of the sleeve to remove excess resin as the sleeve rotates. The sleeve is supported by a support roller **47** inside the sleeve.

A tank **54** contains a fluid resin composition **56**. The composition **56** is a solution or emulsion of a polymer resin. Examples of suitable resins include silicone rubber, polyvinyl chloride (PVC), polyolefins such as polyethylene and polypropylene, ethylene vinyl acetate (EVA), and ethylene methyl acrylate (EMA), and combinations thereof. The resin may be modified to promote water flow on its surface. The fluid resin composition **56** may be at room temperature. It is transferred from the tank **54** to the tray **50** inside the sleeve **44** by means of an air transfer unit **58**, which pumps the fluid through a transfer pipe **60** to the tray. The composition flows from the tray through the opening **49** and channel **55** into the sleeve and through the apertures **48** across the width of the sleeve, assisted by the doctor blade **52**. It is deposited onto the face **26** of the substrate **22** as the substrate travels through the nip **42**, forming spaced-apart spacer elements **24** on the substrate, having the shape of the apertures **48**. The spacer elements retain their shape before drying or curing by means of the viscosity and surface tension of the resin composition. The spacer elements may have a height of about 0.5 mm or higher, alternatively about 0.5 to 2 mm. Their width may be in the range of about 0.75 to 3 mm. A spacer element having a height of about 1 mm may have a width at its base of about 2 mm or more. In order to resist compression when the primary roof structure or exterior cladding is installed, the spacer elements have a hardness, measured as Shore A hardness, greater than 90 and a tensile elongation less than 50%. The spacer elements are to be sufficiently flexible to resist cracking when the wrap is in roll form, and to let out to their original shape when the roll is undone for installation.

In one embodiment of the method, the wrap **20** is then fed into a drying chamber **62**, in which the resin composition of the elements **24** is dried by means of heat. The drying chamber may operate at a temperature of 60-150 degrees C. By the exit of the drying chamber, the elements **24** are securely bonded to the substrate. The wrap is then wound up into a roll on the windup roller **66**. Optionally, a cooling unit **65** may be provided after the drying chamber. In another embodiment, a UV-curing unit **64** is provided instead of a drying chamber. The use of drying, cooling and UV-curing units will depend upon the selection of the resin composition **56**. For example, where a UV-curable resin is employed, the method would use UV-curing rather than drying. Line speeds may be in the range of 5 to 40 meters per minute, depending on spacer density and height.

The pattern of the spacer elements on the substrate is determined by the pattern of the apertures in the sleeve. The spacer elements may be arranged in such a way that when the wrap **20** is rolled up, the tendency for the spacer elements to overlap is reduced, resulting in a more compact, dense roll. If the elements were allowed to be applied in a straight line, they would tend to overlap, resulting in a roll with a lot of air space. The spacer elements may also be arranged in such a way that drainage paths are available regardless of the orientation of the wrap within the wall or roof. The spacer elements may also be arranged in a pattern that does not allow the edges of the exterior sheathing to press down against the substrate, reducing the gap for the drainage of water.

The wrap **20** produced by the foregoing process comprises a weather-resistant, breathable substrate **22** having a plurality of spaced-apart spacer elements **24** on one face **26** of the substrate having a height H, as seen in FIG. **4**. In use, the wrap **20** is applied to the inner sheathing of the wall or roof, for example panels of plywood or particle board, with the spacer elements facing out. The exterior sheathing, such as wood siding or shingles, is applied over the wrap, facing the spacer elements. The spacer elements keep the exterior sheathing separated from the face **26** of the substrate by the distance H, forming a gap for the drainage of water.

In a further embodiment of the invention, the spacer elements are applied to both sides of the substrate. This is accomplished by doing a second pass through the apparatus, in which the wrap **20** coated on one side as described above is processed to apply spacer elements to the opposite side. This form of the wrap is used to promote water drainage on both sides thereof.

Example 1

A substrate comprising a water-impermeable, air-impermeable, water vapor-permeable monolithic film of polyethylene having a width of 9 feet (2.7 meters) and a thickness of 4 mils is fed through a production apparatus of the type illustrated in FIGS. **1**-**3**, at a speed of 20 meters per minute. A fluid resin composition comprising silicone rubber is fed at room temperature to the tray. The silicone rubber composition is fed through the apertures in the sleeve and deposited on the membrane as spacer elements having a height of 1 mm and a width of 1.5 mm. The drying chamber is operated at a temperature of 70 degrees C.

Example 2

A fluid resin composition with PVC was prepared by mixing the following materials in an airtight high-speed mixer for about 30 minutes: (a) 10 kg of PVC: MSP-3 PB1302; (b) 5 kg of DOP; (c) 0.5 kg of precipitated silica: A-365-1200; (d) 3 kg of nanometer CaCO3; and (e) 0.2 kg of viscosity reducer: QIBAOSOL-W-3040.

A substrate comprising a water-impermeable, air-impermeable, water vapor permeable monolithic film of polyethylene having a width of 9 feet (2.7 meters) and a thickness of 4 mils was fed through a production apparatus of the type illustrated in FIGS. **1-3**, at a speed of 20 meters per minute. The fluid resin was fed at room temperature to the tray and fed through the apertures in the sleeve and deposited on the membrane as spacer elements having a height of 1 mm and a width of 4 mm. The drying chamber was operated at a temperature of 150 degrees C. The dried spacer elements were determined to have a Shore A hardness in the range of 91-100, and a tensile elongation in the range of 5%-49%.

Example 3

A fluid resin composition with silicone was prepared by mixing the following materials in an airtight high-speed mixer for about 30 minutes: (a) 10 kg of silicone: 5010; (b) 0.2 kg of catalyst: 9600; (c) 0.3 kg of viscosity reducer: QIBAOSOL-W-4040; and (d) 1 kg of nanometer CaCO3.

A substrate comprising a non-woven and a water-impermeable, air-impermeable, water vapor permeable monolithic film of polyethylene having a width of 7 feet (2.1 meters) and a thickness of 4 mils was fed through a production apparatus of the type illustrated in FIGS. **1-3**, at a speed of 30 meters per minute. The fluid resin composition was fed at room temperature to the tray and fed through the apertures in the sleeve and deposited on the membrane as spacer elements having a height of 0.8 mm and a width of 2 mm. The drying chamber was operated at a temperature of 115 degrees C.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the scope thereof. The scope of the invention is to be continued in accordance with the following claims.

The invention claimed is:

1. A water drainage promoting wrap comprising:

a substrate having a first face, a second face, and a plurality of spaced apart spacer elements on one of the first face and the second face;

wherein the substrate is a membrane permeable to water vapor and substantially impermeable to liquid water and to air;

wherein the spacer elements comprise a base having a width of 2 mm or greater;

wherein the spacer elements have a height of 0.5 mm or greater, a Shore A hardness greater than 90, and a tensile elongation less than 50%;

wherein the spacer elements are configured to define a gap between one of the first face and the second face of the substrate and an exterior sheathing applied over the water drainage-promoting wrap for the drainage of water.

2. The water drainage-promoting wrap of claim **1**, wherein the spacer elements are formed from a dried or cured fluid resin.

3. The water drainage-promoting wrap of claim **2**, wherein the fluid resin composition comprises a solution or emulsion of polymer resin.

4. The water drainage-promoting wrap of claim **1**, wherein the fluid resin comprises one of silicone rubber, a polyolefin, polyvinyl chloride, ethylene vinyl acetate, and ethyl methyl acrylate.

5. The water drainage-promoting wrap of claim **1**, wherein the substrate has a thickness between 3 mil and 22 mil.

6. The water drainage-promoting wrap of claim **1**, wherein the substrate comprises a woven fabric that includes a woven scrim coated on at least one side with a breathable coating.

7. The water drainage-promoting wrap of claim **1**, wherein the substrate comprises a non-woven fabric that is coated on at least one side with a breathable coating.

8. The water drainage-promoting wrap of claim **1**, wherein the substrate comprises a non-woven fabric composite that includes two or more non-woven base fabrics that are coated or laminated together with a breathable coating.

* * * * *